less fancies, and will arrive at absurd conclusions. The speaker then turned to the conceptions of the universe. The world which is known to us changes; if we follow this in the past and future we find, from a physical point of view, a state which approaches perfect rest more and more, without reaching it altogether. But if we suppose that in space worlds arise from worlds without end and perish again, then the successive states, according to the materialistic conception, are of the same value, while according to the philosophical conception they change their relative value by becoming more perfect. The one conception lets the world awaken from dead repose and return to it, the other condemns it to eternal repose. With regard to the extension of the universe in space, the thought that all material space must again and again have limits, leads us to the mathematical conclusion that our earth, just as it is now, reoccurs in infinite numbers in the universe. The speaker then passed to the third point, viz., the demands we make of knowledge. Our knowledge does not go further than to compare observed phenomena and judge of them with regard to others; we understand a phenomenon, understand its value with regard to other phenomena, if either we measure, count, or weigh it, or if we create it ourselves. It is in this latter manner that mathematical science is the product of our mind. The understanding of nature therefore rests in the recognition of the mathematical method in natural phenomena. As by the help of mathematics we understand only relative or quantitative differences, but not qualitative ones, because these cannot be compared, it follows that with regard to the latter scientific understanding is only possible separately within each single individual. Then Prof. Nägeli spoke against the opinion of those who divide nature into a material and a spiritual one, because no naturalist can avoid the conception of a causal connection of mind and body. The finite human mind is a double one; on the one hand it invents and puts the muscles into motion, on the other it contemplates, feels pleasure and pain, hate and love, and remembers. Even without this latter property, therefore, without consciousness, the world would have become world, man would have lived and taught, spoken and made music, but everything only mechanically—man would have been an automaton. Prof. Nägeli then passed from the domain of the mind to that of sensation, explaining that doubtless there was sensation in *all* molecular forces, the *same* sensations in the highest as well as in the lowest stages of organs, in the former only so much more vivid and refined than in the latter. If we understand spiritual life to be the mediator of cause and effect, then we find it everywhere. Du Bois-Reymond, who treated the same subject at Leipzig in 1872, finished his address with the words "Ignoramus et ignorabimus," but Prof. Nägeli ended *his* speech with the proud words—"We know, and we shall know if we are satisfied with human insight."

An address by Prof. Dr. Klebs, of Prague, followed "On the Changes in Medical Views during the Last Decades."

At the final meeting, on the 22nd instant, Prof. Rudolf Virchow gave an address "On the Liberty of Science in Modern State-life," which was received with loud acclamations of approval. After contrasting former with present times, Prof. Virchow said that the last few days had proved that now science enjoys full liberty. We must retain this possession, and must take care not to go too far. Moderation, the resignation of personal predilections, will be necessary to retain the present favourable conditions. The sum total of that which we may designate as true and real science, in the strictest sense of the word, and for which alone we may demand full scientific liberty, is a far more modest one than the domain of speculative expansion of problems and of presentiment. The speaker then in the most detailed and interesting manner drew the limit between speculative investigation on the one side and that which we have recognised as facts on the other. Prof. Virchow is ready to ask that everything which may be considered as a perfectly secured scientific truth, shall be admitted to the scientific treasure of the nation. If now we stand everywhere before reforms in education, and if for natural science a far-reaching consideration is claimed, it must first of all be perfectly clear to us *what* is to be comprised in this science and *what not*, and it cannot be left for the pedagogues to decide, as Prof Haeckel says it ought to be, whether the doctrine of evolution is to be comprised in the programme of education or not. If this doctrine is a scientific truth, and proved beyond doubt, then its admission to this educational programme *must* be demanded, unless we wish to make hypocrites of our teachers. But if it is completely proved it ought to be explained to every child in the schools, not only to the scientific man. The speaker then criticised somewhat severely Prof. Haeckel's theory of the plastidule soul and of the animated cell. As long as the undeniable proofs were wanting, he maintained, we ought, on the contrary, to ask our teachers *not* to teach the evolution doctrine. In the domain of the doctrine of evolution wise moderation is more necessary than anywhere else. For many years Harvey's maxim, "Omne vivum ex ovo" remained undenied; to-day we know for certain that the "omne" is incorrect. In the same way the "generatio æquivoca" may be true or not it certainly is not undeniably proved. In natural science belief and knowledge, *i.e.*, subjective and objective knowledge are united. The domain of dogmatic belief is lessened year after year in favour of objective knowledge which is based upon facts. But apart from the latter, subjective knowledge makes itself very prominent sometimes, and hallucinations and fancies are now and then hid beneath its cover. Anthropological investigations contradict directly the doctrine of evolution. The skulls found in the tombs of the oldest times show a far more human and a far less apish type than do a great many living heads, and we cannot suppose that only the highest-developed skulls of those periods have escaped destruction. Therefore, precaution, moderation, no overrating of our scientific power, for Bacon's "scientia est potentia" is only meant for true objective knowledge.

Many papers of great scientific value were read in the various sections, and we hope to be able to refer to these in a future number.

THE PRESENT POSITION OF THE EVOLUTION THEORY[1]

ON this festive day which unites us here for the opening of the fiftieth meeting of the Association of German Naturalists, universal science may justly point out its relation to the domains of our special investigations. On such a day the educated of all circles, who follow with vivid interest the astonishing progress of the investigation of nature are specially to ask what general results have been obtained for the entire domain of human education. If, therefore, to-day I comply with the honourable request addressed to me, and ask for your kind attention for a short time, I do not think that I can choose a more fitting subject for our common consideration than the relation of science as a whole to that branch of investigation which lies nearest to me, viz., the doctrine of evolution.

No other doctrine has so vividly claimed general attention for the last decade, no other affects our most important convictions so deeply, than the newly-risen doctrine of evolution and the monistic philosophy united with it. Because wholly and solely by this doctrine the "question of all questions" can be solved, the fundamental "question of the position of man in nature." As man himself is the measure of all things, thus naturally the last fundamental questions and the highest principles of all science must depend on the position which our advanced understanding of nature assigns in nature to man himself.

As you know, it is principally to Charles Darwin that the evolution theory of the present day owes this commanding position. Because it was he who, eighteen years ago, first broke through the rigid ice-cover of reigning prejudices, inspired by the same fundamental thought of a monistic development of the world, which a century ago moved our greatest thinkers and poets, Immanuel Kant and Wolfgang Goethe at their head. By the conception of his theory of selection—the doctrine of natural selection in the struggle for existence—Darwin could in particular give a firm foundation to the most important biological part of that doctrine, which had already appeared in the beginning of our century, viz., the theory of descent. In vain the older natural philosophy had then begun the fight for this theory; neither Lamarck and Geoffroy St. Hilaire in France, nor Oken and Schelling in Germany could obtain a victory for it. Just fifty years have now passed since Lorenz Oken began his academical lectures on the theory of evolution here at Munich, and it therefore becomes us here to-day to place a laurel wreath upon the tomb of this deep-sighted zoologist and inspired philosopher. It was Oken also who, in his enthusiasm for scientific unity, called together the first meeting of German naturalists at Jena in 1822, and to whom, for that reason alone, the thanks of this fiftieth assembly are due.

But the natural philosophy of that time could only draw up the general plan of construction and the first outline of the colossal edifice of the monistic theory of evolution; only the zealous and ant-like diligence of half the following century collected the

[1] "On the Evolution Theory of the Present Day in its Relation to Science in general." Address by Prof. Haeckel at the Munich Meeeting of the German Association.

building material for its execution. An immense literature and an admirable perfection of the methods of investigation now give the most brilliant proof of the astonishing progress of the empirical science of nature during that period. But of course the immeasurable widening of the field of empirical observation, and the special division of labour caused by this, often led to an unfortunate dispersion of powers; the higher object of the recognition of general laws was often entirely forgotten in the nearer interest in the observation of details.

Thus it could happen that while this strictly empirical investigation of nature was flourishing at its highest in the years 1830 to 1859, during thirty years, the two principal branches of real natural *history* started from totally different bases. In the history of the development of the earth the conviction gained ground more and more since 1830, the year of the publication of "Lyell's Principles of Geology," that our planet had neither been formed by a supernatural act of creation, nor had passed through a series of total revolutions of mystical origin, but that, on the contrary, a gradual and uninterrupted development had caused its natural formation step by step. On the other hand, in the history of development of the living inhabitants of the earth the old irrational myth remained in full force, according to which every single species of animals and plants, like man himself, had been created independently of one another, and that a series of such creations had followed each other without any genetic connection. The glaring contradiction of the two doctrines, of the natural development-theory of geologists, and of the supernatural creation myth of biologists, was only decided in favour of the former by Darwin in 1859. Since then we recognise clearly that the formation and change of forms of the living inhabitants of our globe follow the same great eternal laws of mechanical development as the earth itself and the whole world-system.

We need not to-day, as we were obliged to do fourteen years ago at the meeting of naturalists at Stettin, cite the reasons and proofs for Darwin's new theory of development. The recognition of its truth has since made its way in the most satisfactory manner. In that domain of natural investigation to which my own labours belong, in the wide field of the science of organic forms or *morphology*, it is already recognised everywhere as the most important basis. Comparative anatomy and the history of germs, systematic zoology and botany cannot to-day do without the theory of descent. Because only by its light the mysterious relations of the numberless organic forms amongst each other can be really explained, *i.e.*, reduced to mechanical causes. Their similarity results as the natural consequence of *inheritance* from common parental forms, their variation as the necessary effect of *adaptation* to different conditions of life. Only by the theory of descent can the facts of palæontology, of chorology, and of œcology, be explained in a way as simple as it is natural; only by this theory we understand the existence of the remarkable rudimentary organs, of the eyes which do not see, the wings which do not fly, the muscles which do not move—nothing but useless parts of the body, which refute in the most emphatic manner the old-fashioned *teleology;* because they prove in the clearest manner that the utility in the structure of organic forms is neither general nor perfect; that it is not the result of a plan of creation worked with an object in view, but necessarily caused by the accidental coincidence of mechanical causes.

Who, in the face of these overwhelming facts, still asks to-day for proofs of the theory of descent, proves by that only his own want of knowledge or reason. But it is utterly wrong to demand exact or indeed experimental proofs. This demand, which is so often heard, results from the widely-spread error that all natural science must be exact; all the other sciences are often confronted with this, under the name of "spiritual or pure sciences" (*Geisteswissenschaften*). Now in truth, only the smaller part of natural science is exact, viz., that part which can be proved *mathematically;* astronomy before all others, and higher mechanics in general; after these the greatest part of what remains of physics and chemistry, also a good part of physiology, but only a very small part of morphology. In this latter biological domain the phenomena are far too complicated and variable to allow of our applying the mathematical method at all. If indeed the demand for a foundation, which shall be as exact as possible, and mathematical if possible, stands good in principle for *all* sciences, it is yet quite impossible to carry this through in by far the greater part of the biological disciplines. Here, on the contrary, the historical and historico-philosophical method takes the place of the exact, mathematical, and physical one.

This applies to morphology before all others, because the scientific understanding of organic forms we obtain solely through the *history of their development.* The great progress of our time in this domain consists in our conceiving the meaning and object of the history of development in an infinitely wider sense than has been done before Darwin. Up to his time it meant only the history of the formation of the organic individual form, which to-day we call *history of the germ*, or *ontogeny.*

If the botanist followed the formation of the plant from the seed, the zoologist that of the animal from the ovum, they considered their morphological task accomplished by the perfect observation of the history of these germs. The greatest men in the domain of the history of evolution, Wolff, Baer, Remack, Schleiden, and the whole school of embryologists formed by them, understood by it, until a short time ago, the individual ontogeny exclusively. It is quite different to-day, when the mysteries of the wonderful history of germs confront us no longer as unintelligible riddles, but have clearly revealed their deep significance; because according to the laws of inheritance, the changes of form which the germ passes through in the shortest time, under our eyes, are a compressed and abbreviated repetition of the corresponding changes of form, which the ancestors of the organism in question have passed through in the course of many millions of years. If to-day we place a hen's egg into the breeding machine, and if twenty-one days later we see a little chicken creep from it, we no longer remain in mute astonishment at the wonderful changes which lead from the simple cell in the egg to the two-leaved gastrula, from this to the worm-shaped and skull-less germ and thence to further germ-forms, which on the whole show the organisation of a fish, an amphibian, a reptile, and only lastly that of a bird. On the contrary, we draw conclusions from this regarding the corresponding series of forms of the ancestors, which have led from the unicellular amœba to the parental form of the gastræa, and further on through the classes of worms, acephala, fishes, amphibia, reptiles, down to birds. The series of germ-forms of the chicken thus gives us a ketch of the series of its real ancestors.

Our biogenetic fundamental law gives the immediate causal connection which thus exists between the ontogeny of any organic individual form and the history of the forms of its ancestors in the following short phrase:—*The history of the germ is an extract from the history of its ancestors*, occasioned by the laws of inheritance. This *palingenetic* extract appears essentially disturbed only in case, through adaptation to the conditions of embryonal life, *cenogenetic* changes have taken place.

This phylogenetic interpretation of the ontogenetic phenomena is, up to the present, the only explanation of the latter. But it receives the most important confirmation and supplementation from the results of comparative anatomy and palæontology. It is of course impossible to prove this by an exact method or indeed an experiment, because all these biological disciplines are, according to the nature of the matter, *historical* and philosophical natural sciences. Their common object is the investigation of historical events, which happened in the course of many millions of years, long before the appearance of the human race on the surface of our youthful planet. The immediate and mathematically exact conception of these events is therefore altogether beyond the reach of possibility.

Only by the critical consideration of the *historical archives*, by a speculation which is just as circumspect as it is daring, an approximate understanding here becomes indirectly possible. Phylogeny uses these historical archives in the same manner and according to the same method as other historical disciplines do. Just as the historian, by the help of chronicles, biographies, and letters draws up a detailed representation of an event long past; as the archæologist by the study of inscriptions, pieces of sculpture, utensils, obtains the knowledge of the state of civilisation of a race long extinct; as the linguist by comparative investigation of all related living languages and their older written documents proves their development and origin from a common ancestral language; just in the same manner the naturalist of to-day, by the critical use of the phylogenetic archives, of comparative anatomy, ontogeny, and palæontology, arrives at an approximate understanding of the events which, in the course of unmeasured periods, have caused the change of forms in the organic life upon our globe.

The history of the parental forms of organisms, or *phylogeny*, can therefore be proved by an exact method or by experiment just as little as this is the case with her older and more favoured sister *geology*. But the high scientific value of the latter is never-

theless now generally acknowledged. Only the ignorant to-day smile incredulously at the explanation that the colossal mountain chains of the Alps, the snow-covered summits of which we see glistening in the far distance, are nothing else but the hardened deposits of the sea. The structure of these stratified mountains and the nature of the fossils they inclose do not admit of another explanation; and yet it cannot be proved in an exact way. In the same manner all geologists now unanimously suppose a certain systematic succession of the mountain strata, corresponding to their different ages; and yet this system of strata is nowhere perfectly present upon the earth. But our phylogenetic hypotheses may claim the same value as is given to these generally recognised geological hypotheses. The only difference is that the enormous structure of hypotheses in geology is far more perfect, simple, and easier to understand, than that of youthful phylogeny.

Thus these *historical sciences of nature*, geology and phylogeny, now form the uniting bond between the exact natural sciences on the one hand, and the historical sciences of the intellect, or pure sciences, on the other. The whole of biology, in particular systematic zoology and botany, are thus raised to the rank of a true natural *history*, an honourable title, which these sciences have borne long ago, but which they only now merit truly. If indeed to-day in many quarters, even in official ones, they are designated as "descriptive natural sciences," and opposed to the "explanatory" ones, this only shows what a false idea had hitherto been entertained of their true object. Since the "natural system" of organisms has been recognised as their *ancestral pedigree*, the living phylogeny of classes and species takes the place of dead descriptive systematics.

However highly we may estimate this enormous progress of morphology, yet it would not suffice by itself to explain the extraordinary effect of the evolution doctrine of to-day upon science in general. This, as you know, rests upon a single special deduction drawn from the theory of descent, upon its application to *man*. The very old question of the origin of our own race is by this theory solved for the first time in a natural scientific sense. If the theory of evolution is true at all, if there exists a natural phylogeny at all, then man also, the crown of creation, has resulted from the form *vertebrata*, from the class *mammalia*, from the sub-class *placentalia*, from the order *apes*. If Linnæus, in 1735, in his system of nature, already united man with apes and bats in the order of primates, if all following zoologists could not move him out of the class of mammalia, then this unanimously recognised systematic position can, phylogenetically, only be interpreted as descent from that class of animals.

All attempts to shake this most important deduction from the evolution doctrine are futile; it is vain to try to keep a particular exceptional position for man, by constructing for him a special line of ancestors, separated from those of the vertebrata. The phylogenetic archives of comparative anatomy, ontogeny, and palæontology, speak too distinctly in favour of an identical and uniform (*einheitlich*) descent of all vertebrata from a single common ancestral form, to permit of our having any doubts on this subject now. Not a single investigator and comparer of languages thinks it possible that languages as widely different as the German, Russian, Latin, Greek, and Indian languages have developed from different original languages. On the contrary, all linguists, by critical comparison of the structure and the development of these different languages, arrive unanimously at the conviction that they all have emanated from a single Aryan or Indo-Germanic mother language. Just in the same way all morphologists arrive at the firm conviction that all vertebrata, from the *amphioxus* upwards to man himself, all fishes, amphibia, reptiles, birds, and mammals descend originally from a single vertebrate ancestor; for we cannot imagine that all the different and highly-complicated conditions of life, which, through a long series of processes or stages of development, led to the typical formation of a vertebrate, have accidentally happened together more than once in the course of the earth's history.

For our consideration to-day only the general conception of the vertebrate-origin of man is of importance, we will not occupy our time with the single ancestral stages of our pedigree. I would only in passing point out that at least the principal stages of the same are now considered as firmly established, thanks to the excellent labours of our most illustrious morphologists, Gegenbaur and Huxley before all others. Of course it is still often supposed that thus, even to-day, only the origin of the human body is explained, but not that of our spiritual activity. In the face of this important objection we must remember, before all else, the physiological fact, that our intellectual life is inseparably united with the organisation of our central nervous system. The latter, however, is composed exactly like that of all higher vertebrata, and originates in exactly the same way. Also, according to Huxley's investigations, the differences between the structure of the brain of man and that of the higher apes are far less important than the corresponding differences between the higher and lower apes. Now as the function or work of each organ cannot be imagined without the organ itself, and as the function is everywhere developed along with the organ, we are forced to suppose that our psychical activity has developed slowly and gradually in connection with the phylogenetic development of our brain.

For the rest this highly significant "soul question" appears to us in quite a different light to-day from what it did twenty, yes, even ten, years ago. Whatever we may imagine to be the nature of the connection of soul and body, of mind and matter, so much results with perfect clearness from the evolution doctrine of to-day that at least all organic matter—if indeed not all matter—is, in a certain sense, animated. First of all, we have been taught by advanced microscopical investigation, that the anatomical elementary parts of organisms, the *cells*, universally possess individual animated life (*allgemein ein individuelles Seelenleben besitzen*). Since Schleiden founded, forty years ago at Jena, the highly-significant cell theory for the vegetable kingdom, and Schwann soon afterwards applied the same to the animal world, we universally ascribe to these microscopical life-beings an individual and independent life; they are the true "individuals of the first order," the "elementary organisms" of Brücke. The grand and highly fertile application which Virchow, in his "Cellular Pathology," made of the cell theory with regard to the entire domain of theoretical medicine, is indeed based upon his considering the cells no longer as the dead passive building stones of the organism, but as the living, active state citizens of the same.

This conception is finally confirmed by the study of infusoria, amœbæ, and other unicellular organisms, because here we find with the single cells, living in isolation, the same manifestation of soul-life, sensation, and conception, volition and motion, as with the higher animals, composed of many cells! Both in the case of these latter social cells, as well as in that of the former hermit-cells, the soul-life of the cell is tied to one and the same most important cell substance—*protoplasm*. We even see in the monera and other most simple organisms that single detached pieces of protoplasm possess motion and sensation, just like the whole cell. Accordingly, we must suppose that the cell-soul, the foundation of empirical psychology, is a compound itself, namely, the total result of the psychic activities of the protoplasm-molecules, which we shortly call plastidule. The plastidule-soul would therefore be the last factor of organic soul-life.

But has the evolution doctrine of the present day thus exhausted its psychological analysis? Not at all! On the contrary, we are taught by modern organic chemistry that the peculiar physical and chemical properties of an element, of *carbon*, in its complicated combination with other elements, cause the peculiar physiological properties of organic compounds, and before all others, of protoplasm. The monera, consisting exclusively of protoplasm, here form the bridge over the deep chasm between organic and anorganic nature. They show us how the simplest and oldest organisms must have originally sprung from anorganic carbon compounds. If therefore in spontaneous generation a certain number of carbon atoms unite with a number of atoms of hydrogen, oxygen, nitrogen, and sulphur to form the unity of a plastidule (or molecule of protoplasm), we must regard the plastidule-soul, *i.e.*, the total sum of its life-activities, as the necessary product of the forces of these united atoms. The sum of the central atomic forces we may call atom-soul in a consequentially monistic sense. By accidental meeting and varied combination of the constant and unchangeable atom-souls the diverse and highly variable plastidule-souls originate, the molecular factors of organic life.

Arrived at this most extreme psychological consequence of our monistic doctrine of evolution, we meet with those old conceptions of the animation of all matter, which already in the philosophy of Democritus, Spinoza, Bruno, Leibnitz, and Schopenhauer have found varied expression; because all soul-life can finally be reduced to the two elementary functions of *sensation* and *motion*, to their reciprocal action in reflex motion. The simple

sensation of inclination and disinclination (*Lust und Unlust*), the simple form of motion, *attraction* and *repulsion*, these are the true elements out of which all soul-activity is built in infinitely varied and complicated combination. "The hating and loving of atoms," attraction and repulsion of molecules, motion and sensation of cells, and of the organisms composed of cells, the formation of thought, and the consciousness of man, these are only different stages of the universal psychological process of evolution.

The unity in the conception of the universe (or "monism") to which the new doctrine of evolution thus leads us, annuls the opposition which hitherto existed between the different dualistic world systems. It avoids the one-sidedness of materialism as well as that of spiritualism, it unites the practical idealism with the theoretical realism, it combines natural science with mental science (*Geisteswissenschaft*) to form an all-comprising uniform general or total science.

As thus we recognise the evolution doctrine of to-day to be a uniform and uniting cement of the most heterogeneous sciences, it gains the highest significance not only for the pure and theoretical but also for the practical and applied sciences. Neither practical medicine as an applied natural science, nor practical politics, jurisprudence and theology, in as far as they are parts of applied philosophy will in future be able to escape its influence. On the contrary we are convinced that it will prove, on all these domains, to be the most important lever of progressive knowledge as well as of ennobled civilisation in general. Now as the most important point of attack of the latter is the education of the young, the evolution doctrine will have to claim its just influence in the school as the most important means of education; here it will not be only tolerated, but it will become a ruling and guiding element.

If, finally, we are allowed to indicate, in a few words, at least the most important points of this relation, we may first of all lay stress upon the high significance of the genetic method in itself. Teachers as well as those they teach will contemplate each subject of their studies with infinitely greater interest and understanding, if, before all else, they ask themselves, "How did this originate? How did it develop itself?" Because in this question as to development the question as to the causes of facts is comprised; but after all it is always the recognition of the effecting causes, not the mere knowledge of facts, which satisfies the constant want of causalities of our mind. The recognition of common simple causes for the most varying and complicated phenomena leads to the simplification as well as to the deepening of our education and culture; only by causal conception dead knowledge becomes living science. Not the quantity of empirical knowledge, but the quality of it's causal conception, is the true measure of the education of the mind.

How far the outlines of the general doctrine of evolution are now to be introduced into schools, in what succession its most important branches—cosmogony, geology, phylogeny of animals and plants, anthropogeny—are to be taught in the different classes, this we must leave to practical pedagogues to determine. But we believe that a far-reaching reform of education is unavoidable in this direction, and that it will be crowned with the most perfect success. How infinitely, for instance, the important teaching of languages will gain in educational value, if it is done comparatively and genetically! How the interest in physical geography will grow if it is genetically taught together with geology! How the tedious, dead systematics of the species of animals and plants will gain life and light if the two are explained as different branches of a common pedigree! And what a different conception we will, before all else, obtain of our own organism if we recognise it no longer as the fictitious likeness of an anthropomorphous creator, but in the clear daylight of phylogeny as the highest developed form of the animal kingdom; as an organism, which in the course of many millions of years has developed itself gradually from the line of vertebrate ancestors, and has far surpassed all its relatives in the struggle for existence!

As the doctrine of evolution will thus act in a fertilising and furthering way upon all branches of education, it will at the same time produce the consciousness of their monistic connection in the minds of both teachers and pupils. As historical natural science it will step as mediator and conciliator between the two opposed directions which to-day compete for power in the higher educational schools; on the one side the older, classical, historical, philosophical direction, on the other the newer, exact mathematical, physical direction. Both directions of education we think equally justified and equally indispensable; the human mind will only reach its full harmonious education, if both are equally taken into account. If formerly classical education was favoured too exclusively and one-sidedly, this has happened only too often recently with exact education. Both excesses the doctrine of evolution reduces to their proper measure, as it steps as a uniting bond between exact and classical science, between that of nature and that of the mind. Everywhere it teaches the living course of the connected, monistic, and uninterrupted development. Everywhere it shows to the zealous investigator new scientific aims beyond those already attained, and thus "gently leads the striving mind nearer and nearer to truth." The infinite perspective of progressive perfection which the doctrine of evolution thus opens before us is at the same time the best protest against the unfortunate "Ignorabimus," which it is obliged to hear now from many quarters, because nobody can predict what "limits of natural understanding" the human mind in the further course of its astonishing development will yet overstep in future!

By far the most important and most difficult demand which practical philosophy addresses to the evolution doctrine seems to be that of a new doctrine of morals (*Sittenlehre*). It is certain that afterwards, as before, the careful training of the moral character will remain the principal task of education. But up to the present the widest circles held the conviction firmly that this most important problem could only be solved in connection with certain ecclesiastical dogmas. Now as these dogmas, particularly in their union with very old myths of creation, directly contradict the principles of the doctrine of evolution, it was believed that through the latter religion and morals were endangered in the highest degree.

We consider this fear an erroneous one. It arises from the constant mixing up of the true and reasonable natural religion with the dogmatic, mythological church religion. The comparative history of religions, an important branch of anthropology, acquaints us with the great variety of external shells, in which the different people and times, according to their individual character and requirements, clothe religious thought. It shows us that the dogmatic teachings of church religions themselves are in a slow uninterrupted course of development. New churches and sects arise, old ones perish; at the best a certain form of creed lasts a few thousand years, an insignificantly small lapse of time in the æon-series of geological periods. Finally we are also taught by the comparative history of culture, how little true morality is necessarily united with a certain ecclesiastical creed. Often the greatest coarseness and decay of morals go hand in hand with the absolute power of an almighty church. We need only think of the middle ages! On the other hand we see the highest stage of moral perfection attained by men who have separated themselves from all ecclesiastical beliefs.

Independently of all church creeds, the germ of a true religion of nature lives in the breast of every man; it is connected inseparably with the noblest features of human existence itself. Its highest command is *love*, the restriction of our natural egotism in favour of our fellow men, for the benefit of human society, of which we are the members. This natural moral law is far older than all church religion. It has developed from the social instincts of animals. With animals of very different classes, particularly with mammals, birds and insects, we find its beginnings. According to the laws of association and of division of labour, many individuals here unite to form the higher community, called a state or hive. Its existence is necessarily connected with the reciprocal action of the members of the community, and with the sacrifices they make to the whole at the expense of their egotism. The consciousness of this necessity, *the feeling of duty*, is nothing else but a social instinct. But instinct is always a psychic habit, which, acquired originally by adaptation, has become inheritable in the course of generations, and finally appears as innate.

To convince ourselves of the admirable power of the animal feeling of duty, we need only destroy an ant-hill. There we at once see in the midst of destruction thousands of zealous state citizens occupied not with the salvation of their own dear lives, but with the protection of the cherished community to which they belong. Courageous warriors of the ant state set themselves up in powerful defence against our interfering finger; those that tend the young save the so-called "ants' eggs," the beloved pupæ, upon which rests the future of the state; diligent workers at once begin with undaunted courage to clear away the *débris*, and to construct new dwellings. The admirable organisation of these ants, of bees and other social animals, have originally developed from the crudest beginnings, just in the same manner as did our own human civilisation.

Even those most tender and most beautiful features of the human mind, which we principally glorify in poetry, we find already formed in the animal kingdom. Have the intense maternal love of the lioness, the touching matrimonial love of parrots ("inseparables"), the sacrificing faithfulness of the dog not been proverbial for ages? The most noble feelings of compassion and love, which determine actions, are here as with man, nothing but ennobled instincts. In connection with this conception, the ethics of the evolution doctrine need not look for new maxims, but reduce the very old commands of duty to their natural scientific base. Long before the origin of all church religion these natural commands of duty ruled the lawful living together of mankind as well as of social animals. Church religion ought to profit by this significant principle, not to combat it; for the future does not belong to that theology which conducts a fruitless battle against the victorious doctrine of evolution, but to that one which takes possession of it, recognises and uses it.

Therefore, far from fearing a shaking of all valid moral laws, and an obnoxious emancipation of egotism by the influence of the evolution doctrine upon our religious convictions, we, on the contrary, expect from it a reasonable confirmation of the moral doctrine on the unshakable basis of firm natural laws; for with the clear conception of our true position in nature, anthropogeny opens to us at the same time an insight into the necessity of our very old precepts of social duty. Henceforth practical philosophy and pedagogics will, like theoretical general science, deduce their most important maxims, not from supposed revelations, but from the natural principles of the doctrine of evolution. This victory of monism over dualism opens to us the most hopeful prospect for an infinite progress of our moral as well as of our intellectual development. In this sense we greet the evolution doctrine of to-day, as recently founded by Darwin, as the most important impulse of the whole of our pure and applied sciences.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The Oxford University Commissioners having decided upon suspending two out of the three fellowships now vacant at All Souls' College, only one fellow will be elected in November.

BRISTOL.—The introductory lectures at the opening of University College, Bristol, commence on the 9th inst. Prof. Letts opens the chemistry class on the 10th with an address on "Old and New Views on the Nature of Matter," and Prof. S. P. Thompson the class of experimental physics on the 12th, with an address on "The Methods of Physical Science." The evening classes will be opened about a week later. Mr. J. F. Main, B.A., D.Sc., Scholar of Trinity College, Cambridge, has been appointed Lecturer in Mathematics and Applied Mechanics.

LEEDS.—The Yorkshire College, as it is now called, has published a neat calendar of about 100 pages in the orthodox grey colour characteristic of similar publications. The calendar contains all needful information on the organisation and business of the College, which now possesses six chairs, representing the main departments of science and literature, besides a chair of civil and mechanical engineering and one of textile industries. Judging from the course of study laid down for each class, and from the reputation of the professors, a high-class liberal education is now within easy reach of all Yorkshiremen. The calendar includes a prospectus of the Leeds' School of Medicine. For the coming session a much extended system of outside lecturing is announced, especially the arrangement made with the Gilchrist Trustees, through their secretary, Dr. W. B. Carpenter, F.R.S., by which some of the college professors will deliver four series of "Science Lectures for the People" in Leeds, Bradford, Halifax, and Keighley.

SOCIETIES AND ACADEMIES

LONDON

Entomological Society, September 5.—Prof. J. O. Westwood, M.A., president, in the chair.—Mr. F. Smith exhibited, on behalf of Mr. G. A. J. Rothney, a remarkably fine collection of Hymenoptera from Calcutta. Among them were several new species of *Cerceris* and a few new species of *Apidæ*.—Mr. McLachlan exhibited drawings with details of *Himantopterus fuscinervis*, an extraordinary insect from Java, described by Wesmael, in 1836, as belonging to the Lepidoptera. Dr. Hagen transferred the genus to the Neuroptera, in 1866, but Mr. McLachlan had recently examined the unique specimen in the Brussels Museum, and had decided that it was truly lepidopterous. Mr. McLachlan also exhibited leaves of a large species of *Acer* from trees growing in a garden in the neighbourhood of Brussels. Almost every leaf had been mined by the larva of a small saw-fly (*Phyllotoma aceris*), a species occurring in England. This insect only appeared in the locality mentioned last year, and yet was found by Mr. McLachlan in enormous numbers.—Prof. Westwood exhibited specimens of a minute Hymenopteron from Ceylon allied to the British *Mymar pulchellus*.—Prof. Westwood also exhibited males and females of the rare beetle *Narycius smaragdulus*, from India. This insect had remained almost unknown since the time of its description by the exhibitor in 1842.—Mr. James Wood-Mason, of the Calcutta Museum, exhibited the two sexes of *Phyllothelys Westwoodi* (*Mantidæ*), which species was remarkable on account of the presence of a large frontal horn in the female not represented in the male.—Mr. Wood-Mason also exhibited a beautifully-executed drawing of a stridulating spider (*Mygale stridulans*) in a stridulating attitude, and likewise specimens of stridulating scorpions, from India. Mr. Mason also handed to the president for identification, an homopterous insect with what appeared to be the larva of some case-bearing lepidopterous insect attached to it.—Mr. P. Wormald exhibited, on behalf of Mr. Pryer, a small collection of Chinese Lepidoptera.—Mr. G. C. Champion exhibited some rare beetles from Aviemore, Invernesshire; among them a new British Longicorn, *Pachyta sexmaculata*.—Mr. J. Jenner Weir mentioned a case of parthenogenesis in *Lasiocampa quercus* which had recently come under his notice.—The president read a letter from Herr Grevelink, of the Hague, relating to the insect which destroys the West Indian cocoa-nut trees (*Aleyrodes cocoïs*).—The Secretary exhibited a Longicorn beetle, which had been forwarded from Birkenhead by Mr. David Henderson.—Mr. J. W. Slater read a paper entitled "Vivarium Notes on some Common Coleoptera."

GÖTTINGEN

Royal Academy of Sciences, April 23.—The dates of Genesis, by M. Oppert.

April 30.—Celebration of the centenary of Gauss's birthday.

May 5.—On the mutual relations of magnetising force, temporary and permanent magnetism, by M. Fromme.—Experiments on the apparent attraction and repulsion between bodies moving in water, by M. Schiötz.—On the same, by M. Bjerknes.—Experimental investigation on the resistance of flames to the galvanic current, by M. Hopper.

July 7.—Demonstration of a tangent multiplier constructed on a new principle, by M. Riecke.—Remarks on some transformations of surfaces, by M. Enneper.—On the border-angle of the expansion of liquids on solid bodies, by M. Quincke.—On geometrical extensions of the Bezout fundamental law, by M. Schubert.—On the structure and systematic position of the genus Carludovica, by M. Drude.—Communication on the pyro-electricity of tourmaline, by M. Hoppe.

CONTENTS